Space Weather Research at the National Science Foundation

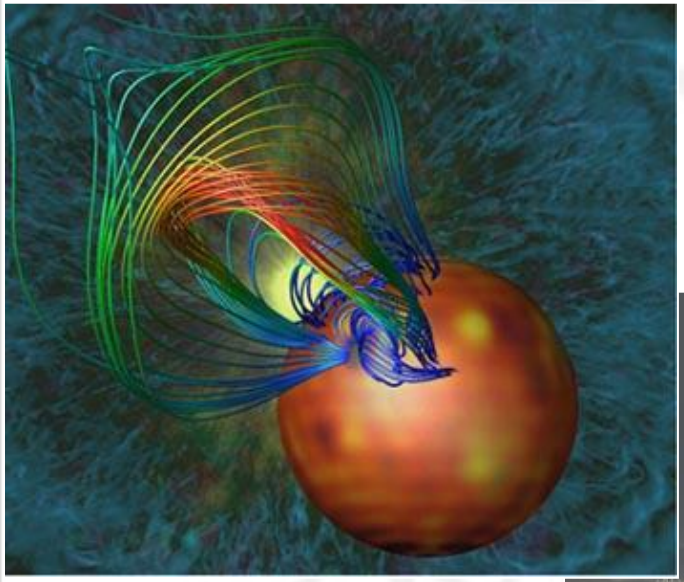
Therese Moretto Jorgensen
Geospace Section
Division of Atmospheric & Geospace Science

April, 2016

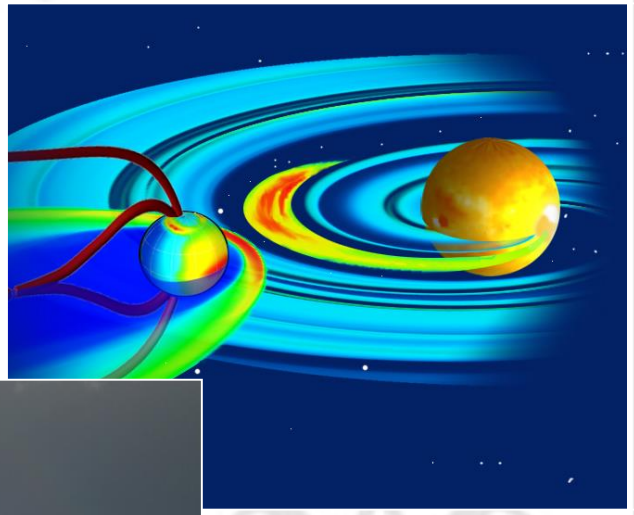
Advancing Fundamental Knowledge

Tackling the key science questions for space weather

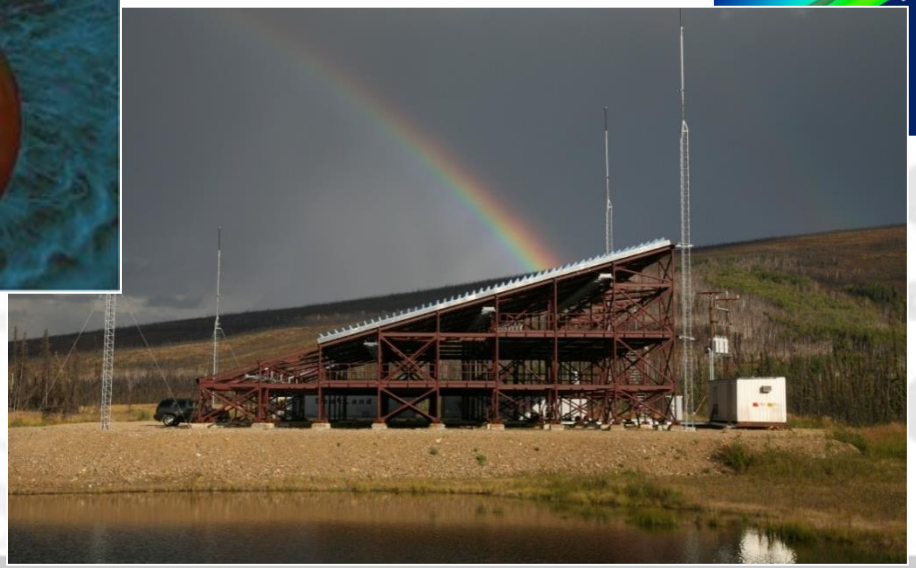
Understanding processes



Improved Sun to Earth models

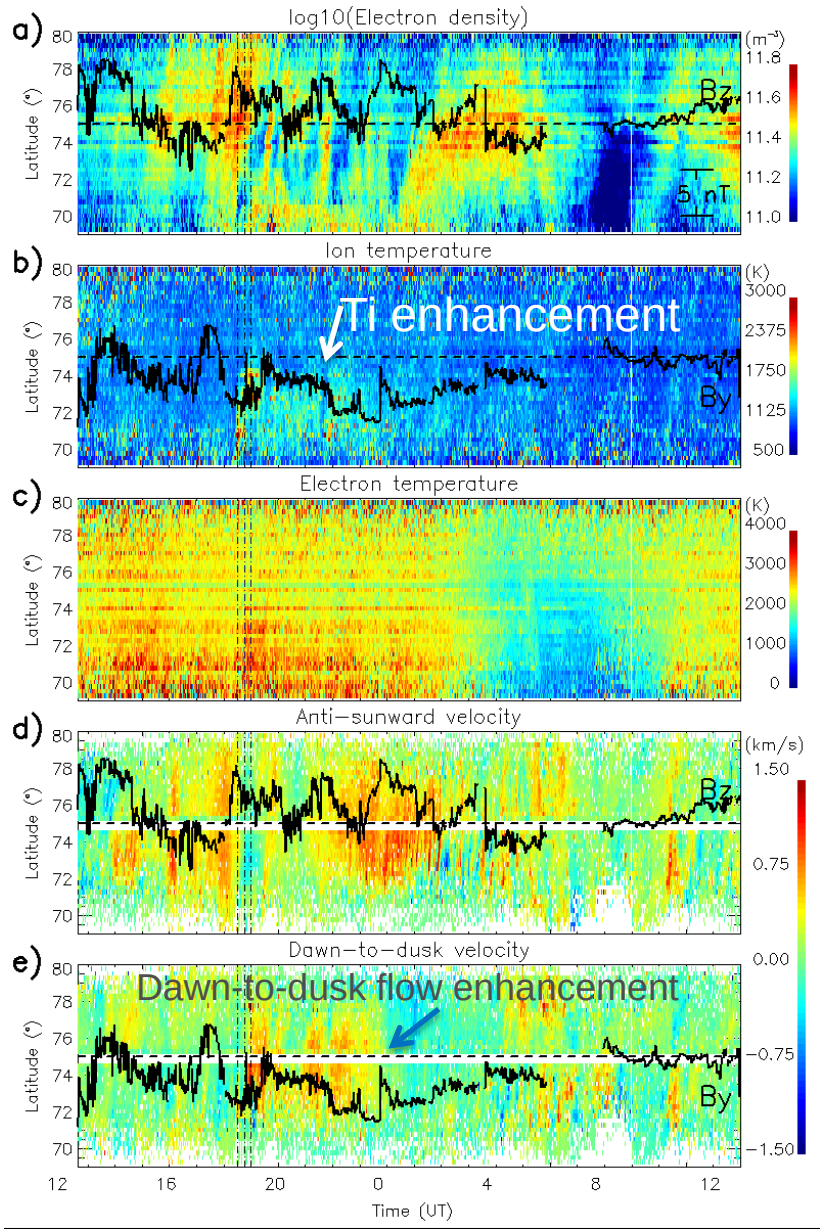


Better observations



Figures courtesy of R. Gilles
University of Calgary

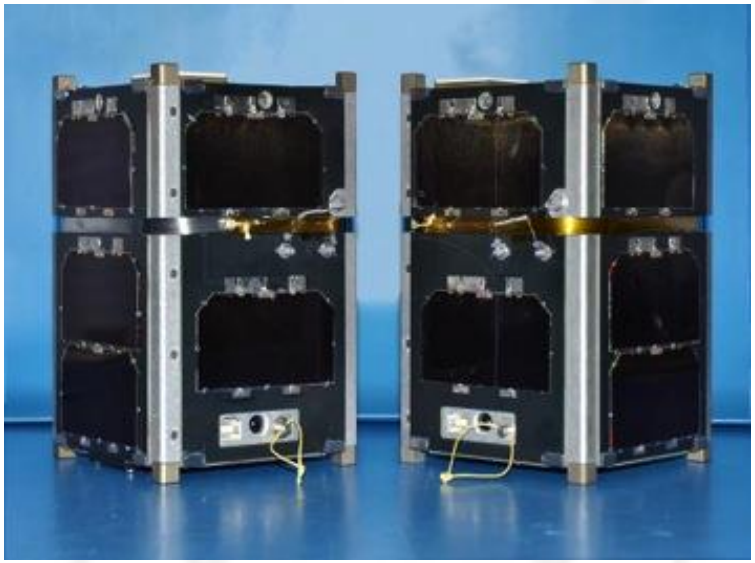
First Coordinated Observations between RISR-C and RISR-N, August 2015



- Longitude-averaged parameters from a combined RISR-C and RISR-N 25-hour experiment
  - Clear consistency in the measurements and a combined, extended field of view of >10^{o} latitude

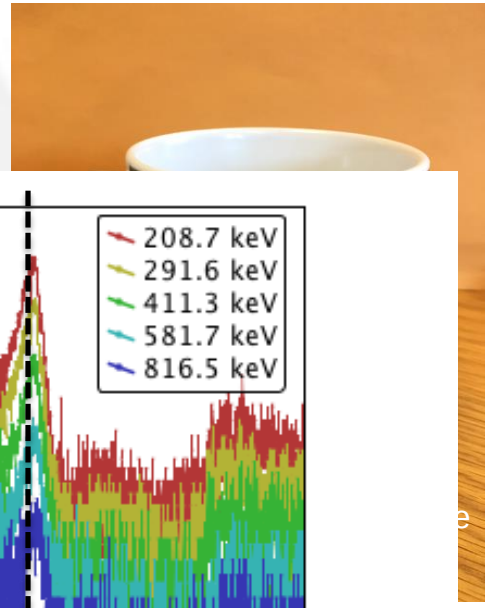
PI: Nicolls, SRI Int.

CubeSats



PI: Spence, U. New Hampshire & Klumpar, Montana St. U

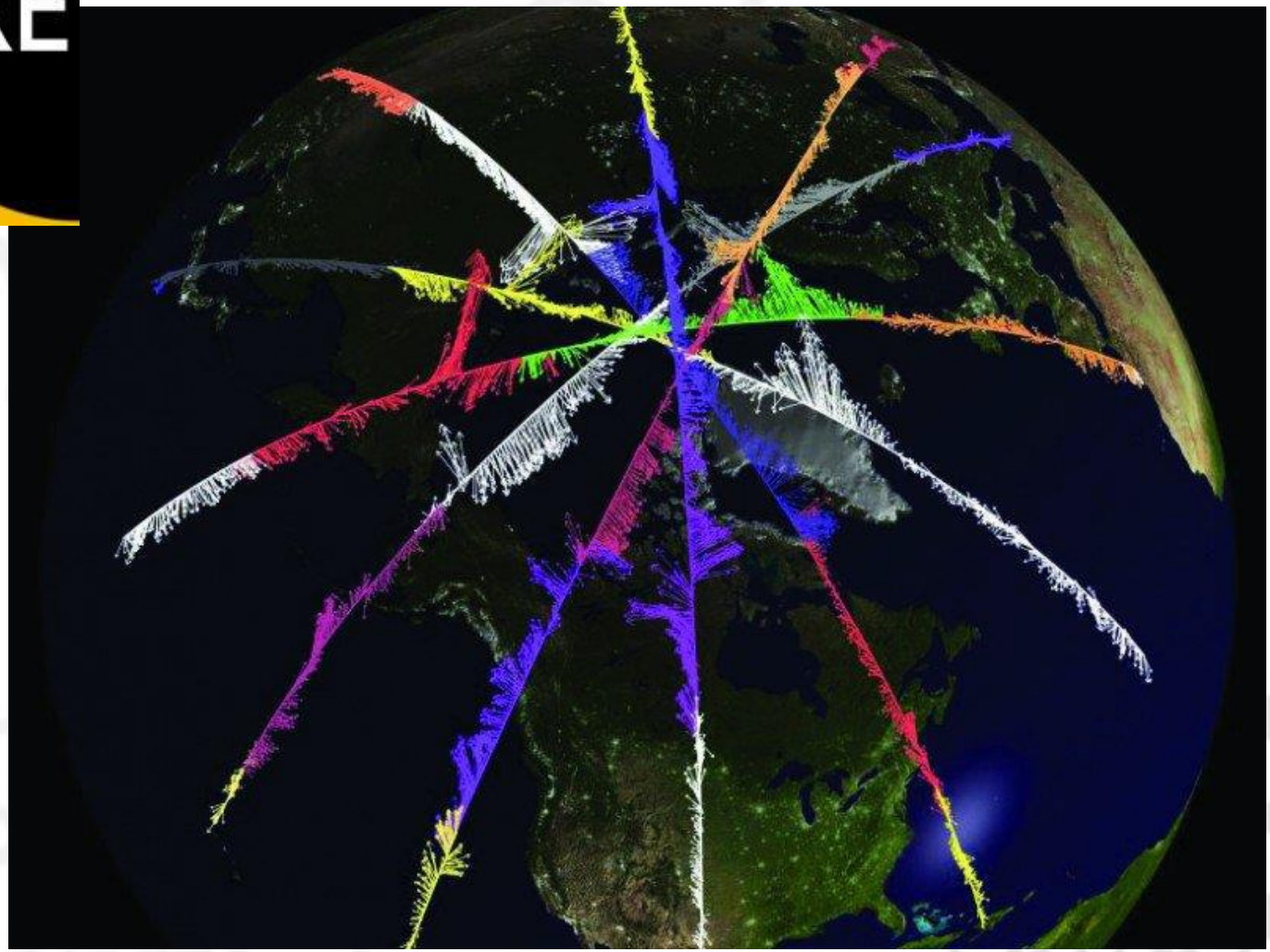
CubeSats



FU3 (Surface)
10^1
10^0
10^{-1}
10^{-2}
208.7 keV
291.6 keV
411.3 keV
581.7 keV
816.5 keV
19:28:40
19:29:00
19:29:20
19:29:40
19:30:00
FU4 (Collimated)
10^1
10^0
10^{-1}
10^{-2}
251.5 kev
333.5 kev
452.0 kev
620.5 kev
852.8 kev
19:25:40
2015-06-11
19:26:00
19:26:20
19:26:40
19:27:00
Time

t. U

AMPERE



PI: Anderson, JHU/ APL

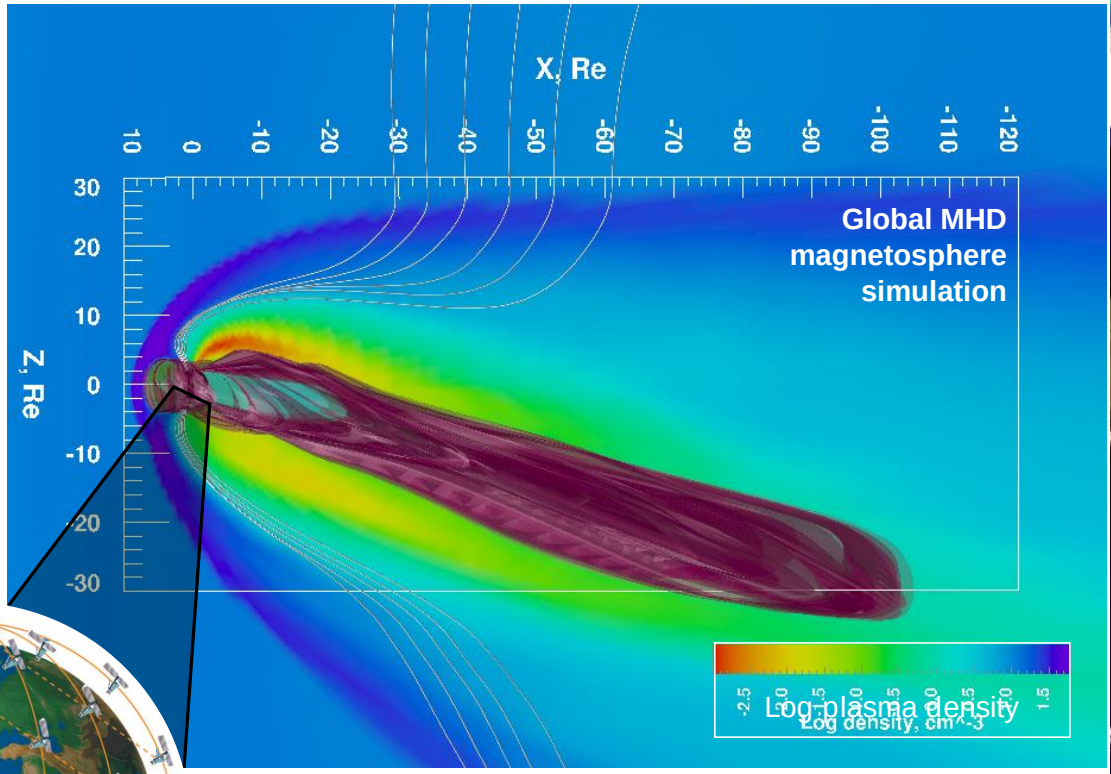
AMPERE

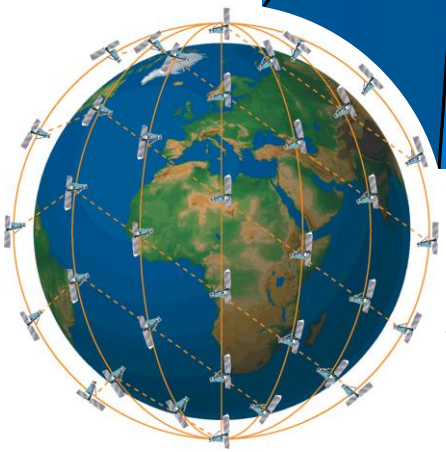
Full Coverage | Partial Coverage | Back Data Purchased

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2009	Pre-AMPERE											
2010												
2011												
2012												
2013												
2014												
2015												
2016												

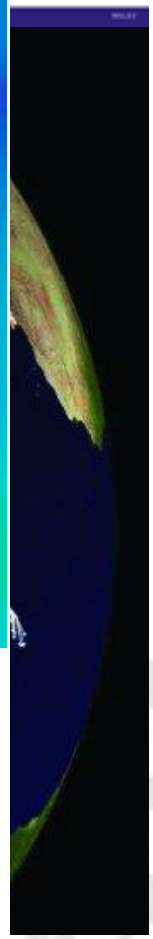
PI: Anderson, JHU/ APL

Iridium constellation measures low-altitude magnetic perturbations due to field-aligned currents. These measurements can be used for assimilation in global magnetosphere models.





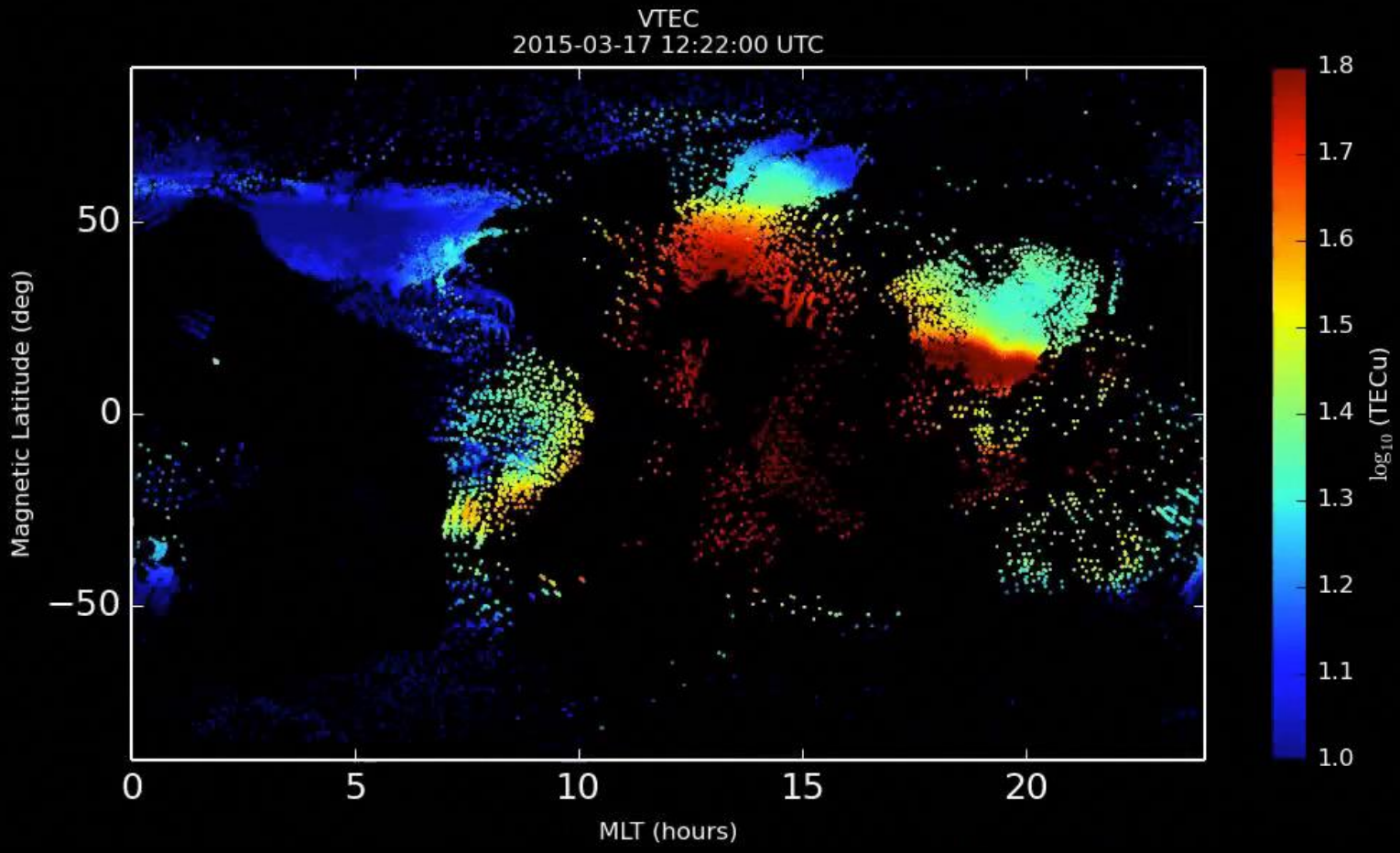
The magnetosphere stretches to large distances under the influence of the solar wind. Field-aligned currents flow between the magnetosphere and ionosphere and generate ionospheric plasma convection. The motional ionospheric electric field maps back to the vast volume of the magnetosphere and regulates its plasma circulation.



Merkin et al.(2016), Space Weather, 14

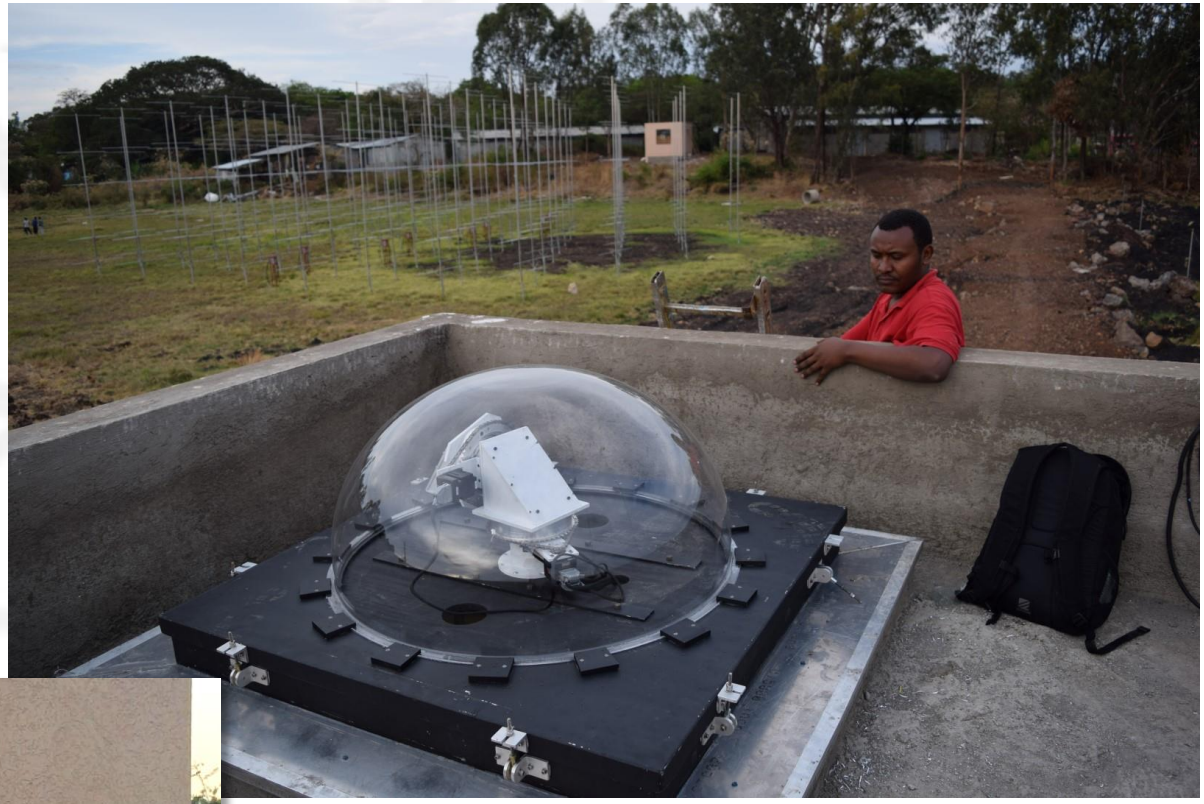
PI: Anderson, JHU/ APL

High resolution VTEC maps



PI: Coster, MIT Haystack

Fabry-Perot observatory located at Bahir Dar University campus, Ethiopia with the Ethiopian graduate student working on the project.

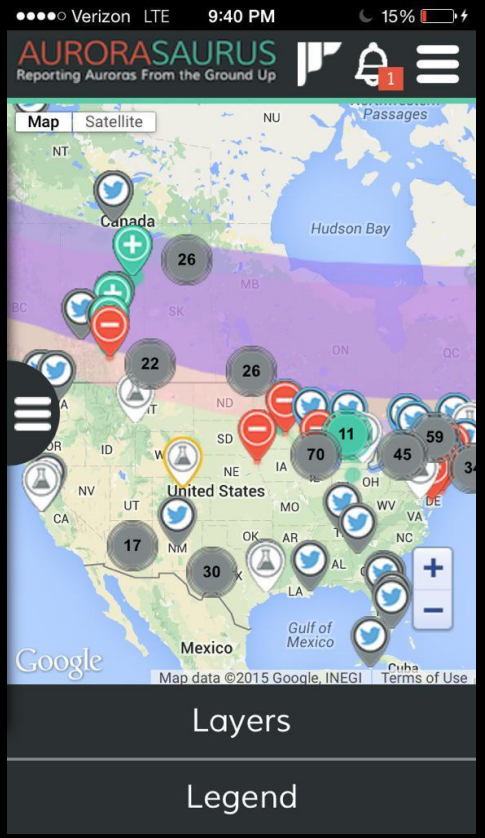


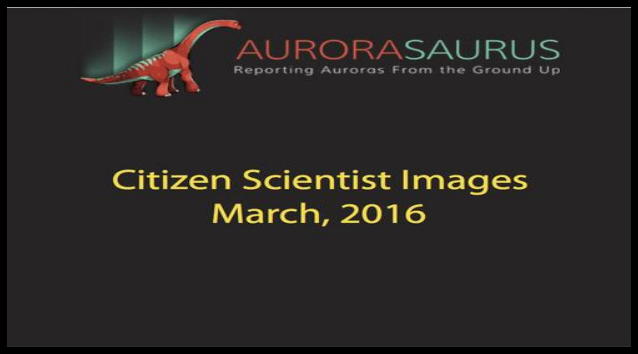
A Brazilian student at Clemson U. oversaw the installment and helped train his Ethiopian colleagues.

PI: Makela, U. Illinoes & Meriwether, Clemson U.

AURORASAURUS

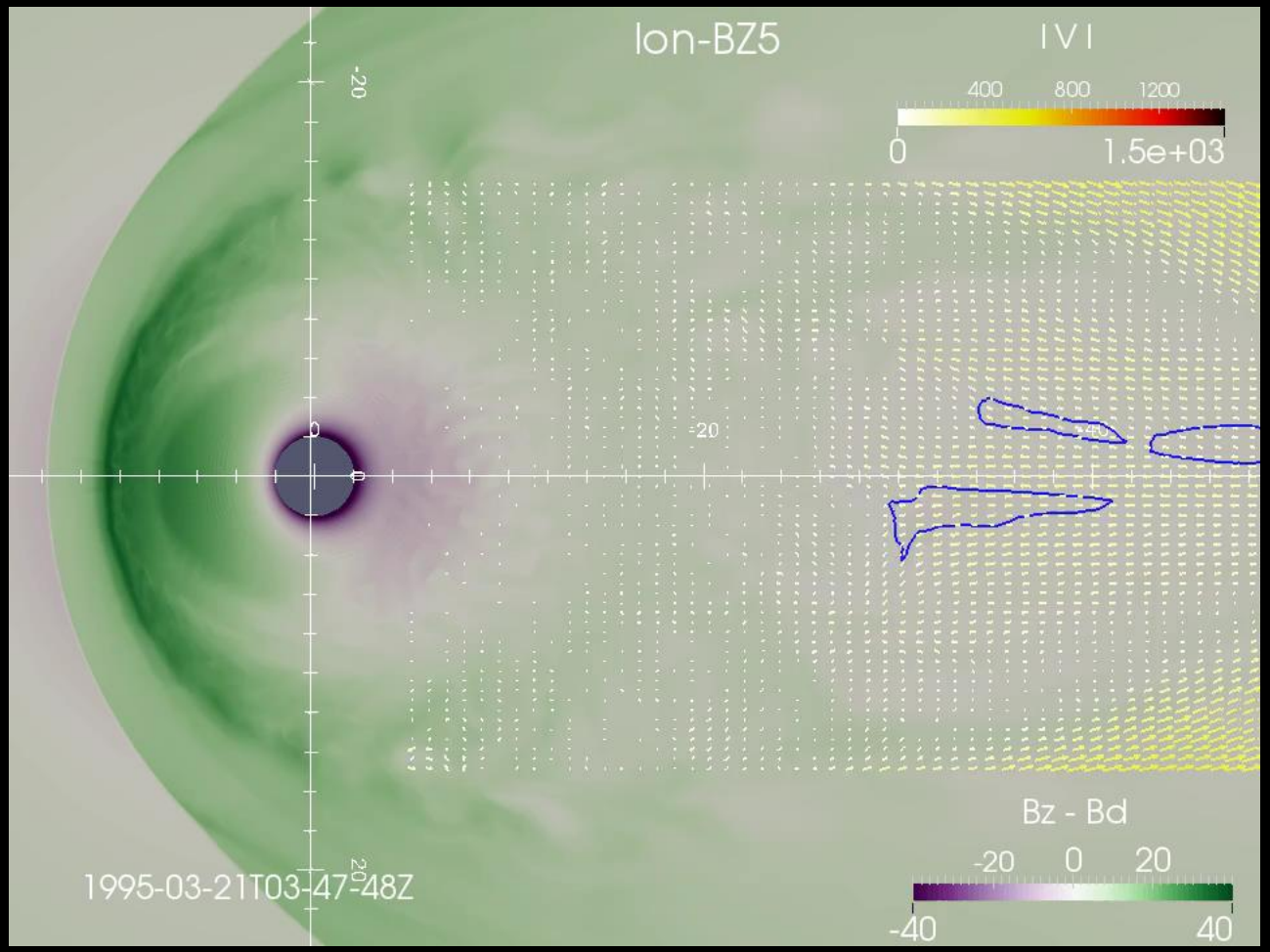
Reporting Auroras From the Ground Up





- *A new, open innovation, geospatial, crowdsourcing, open source platform and public-private partnership…*
- Join us!
- POC: **Elizabeth MacDonald**, eliz.macdonald@gmail.com

“Bursty Bulk Flows” in High Res LFM Model

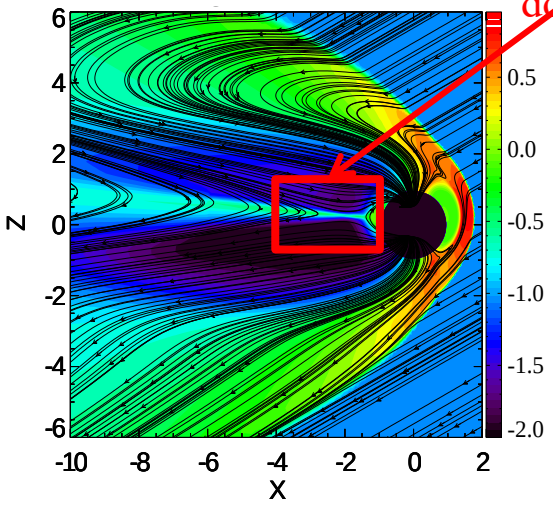


Wiltberger et al., NCAR/HAO

Mercury Simulation with MHD-EPIC

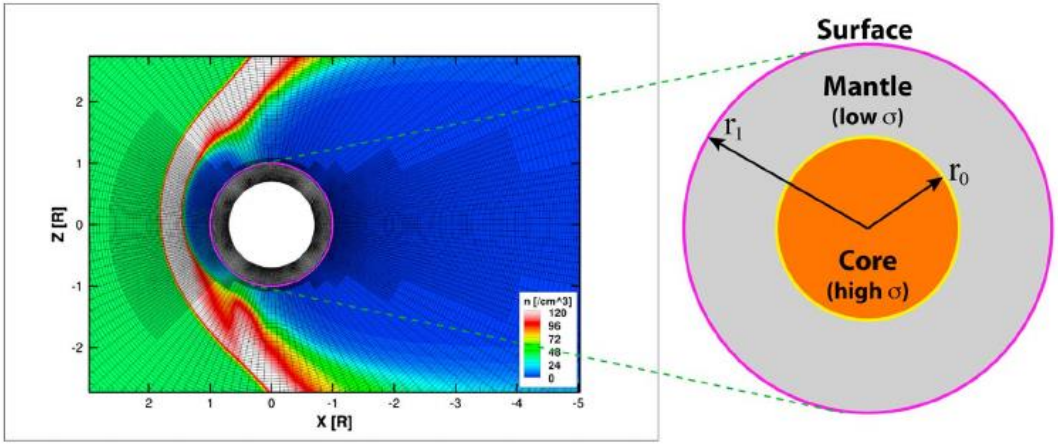
log p and field lines

PIC domain

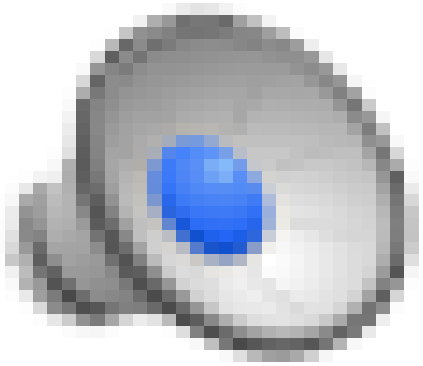


Hall MHD

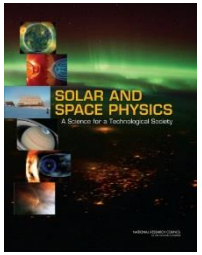
Stretched spherical grid and resistive body



MHD-EPIC



Geospace Sciences Portfolio Review and Motivations



- NRC's Decadal Survey: *Solar and Space Physics – A Science for a Technological Society*, and the "DRIVE" initiative
- Changing needs, e.g. increased focus on Geospace System Science and modeling, and the observations that support that.
- Assessment of state of infrastructure
- Current flat budget and outlook

The final report is available here:
https://www.nsf.gov/geo/geoac_subcomm_rpts.jsp

Quo Vadis?

Community initiative to define the experimental infrastructure required for discovery research in the 21st century driven by cutting edge observations of the system

Workshop:

"Exploring the Geospace Frontier: Quo Vadis".

Dates: 25-27 May 2016 at HAO

Dave Hysell, Cornell; Scott McIntosh, HAO;
Jeff Thayer, UC Boulder

PREEVENTS

PREDICTION OF AND RESILIENCE AGAINST EXTREME EVENTS

Natural hazards including space weather

- Enhance understanding of fundamental processes
- Improve capability to model and forecast events

Announced Sep 2015

Two tracks: co-funding and larger projects

Solicitation for Track II expected in May 2016 with deadline in September 2016

CONCLUSION

- Space Weather is an active field of basic research
- Funding is limited so we have to creative and collaborative

Space Weather Action Plan Activities
Goal 1: Develop Benchmarks

Phase 1: Initial benchmarks based on existing studies

- NSF Staff contribute to all 5 working groups

Phase 2: Development of Scientifically and statistically rigorous benchmarks

- Developing plans for engaging the scientific community – in collaboration with NASA

Space Weather Action Plan Activities
Goal 5: Advancing Understanding and Forecasting

CEDAR, GEM, and SHINE Programs

- Facilitate research collaboration on coupling and interaction

NASA/NSF Collaborative Space Weather Modeling

- Large-scale modeling efforts that require community teamwork

NASA/NSF Community Coordinated Modeling Center, Goddard

- Development of models for transition to operational use

AMPERE, SuperDARN and SuperMAG

- Global networks of space weather relevant observations

Neutron Monitor network

- Community Workshop to assess current state and future potential Oct 2015; Report expected soon

SuperMAG

AMPERE

Space Weather Action Plan Activities
Goal 5: Advancing Understanding and Forecasting

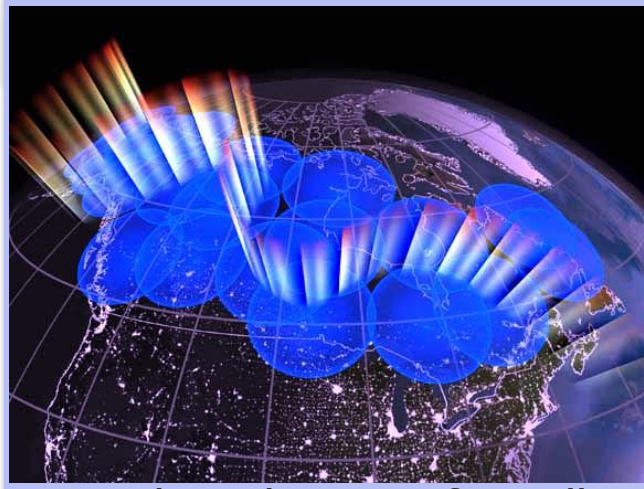
Research Priorities

- Series of community workshops initiated October 2015: impacts assessments to inform priorities
- Decadal survey and portfolio review

Potential Future Developments

- Enhanced global network (DASI)
- New advanced instruments, e.g. CoSMO
- ***Exploring the Geospace Frontier: Quo Vadis?*** Community workshop May 2016
- NASA/NSF Collaborative efforts to address large cross-disciplinary problems, e.g. Heliophysics Science Centers

Next Generation Space Weather Observations



Distributed Array of Small Instruments (DASI)

Coronal Solar Magnetism Observatory